Van de Warker (Ely)

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(With three woodcuts.)

A. Summary of the evidence of authors.

Mobility of the uterus is inseparable from a due performance of its functions. In this sense we may say that this normal and essential mobility is an endowment, the result of the peculiar method of suspension of the uterus by its ligaments and its cellular connection. Whatever position the organ may assume, presuming an antecedent normal development, is the direct outcome of these conditions.

A knowledge of the normal position and range of movements of the uterus is essential to a proper understanding of the pathological variations both of position and form. Having this great practical importance, we shall give a careful study to the subject.

Before entering upon an investigation of the anatomy of the organ and its supports, so far as they may bear upon this question, it will be instructive to examine the views of those who have studied the subject. Here we are met by the difficulties that always attend conflicting and irreconcilable testimony. Even the practical importance of this matter is regarded from two opposite points of view. Some authors look upon the

uterus as having no relatively fixed position and consequently give it but slight importance (Cruveilhier, Aran); while others claim for the normal position great practical value, even when admitting the error of assigning the organ a mathematical certainty of position (Hueter).

Schultze refers much of the difference in opinion as to position of the uterus to the opposing points from which it is viewed by the anatomist and the gynecologist. It is undoubtedly true that, while we must resort to the dead subject for a study of the machinery of support, the actual position of the organ in the living must be studied from the living. Keeping this in view, much that is divergent in the statements of authors may be reconciled.

The testimony of authors falls naturally under four heads.

(*a*). The form and position of the immature uterus.

(*b*). The normalization of the anterior position and curve.

(*c*). The conditions attending the normal backward and erect positions.

(*d*). The position of the uterus in the cadaver.

(*a*). An examination of the fetal uterus, at which period the neck exceeds many times the body in weight, shows that the organ is considerably flexed forward; the body of the organ is pressed generally to the right and forward, by the rectum distended with meconium. More rarely the organ is developed completely straight, while occasionally the retroflexed condition of the infantile organ is observed. This leads Edward Martin to the conclusion that anteflexion is not an essential stage of development but the cause must be sought in accidental conditions. These conditions are partly the result of the great flexibility of the imperfectly developed organ, particularly at the isthmus uteri, the pressure of meconium, and, at the later period of development, of feces and gas in the rectum and other intestines, which press the body from behind and above. Friederich Hach, as a result of frozen pelvic sections made upon the new-born, comes to the conclusion that the uterus is curved (bogenförmig) on its anterior wall, as the result of rectal distention.

Klob somewhat modifies this view of Martin by the opinion that before and at the beginning of puberty the uterus is neither ante- nor retroflexed, but at the first period of adult

development the organ shows a slight anterior curvature, in consequence of which the convexity of the uterus approximates the posterior wall of the bladder. The cause of this is sought in the unlike development in the mass of the organ of the submucous connective-tissue layer, which Rokitansky asserts is developed in excess in the posterior wall in the region of the internal neck. The opinion of Martin is sustained by Boullard, Vermeuil, Gosselin, Porchat, Picard, Aran, Soudry, Piachaud, Cusco, and others, both as to the frequency of anteflexion and the rarity of the opposite form of the organ. The difficulty of explaining the evolution of the puerile into the more erect form of the normal adult organ is met by Penas with the statement that "with increasing age the organ tends to redress itself." Others hold that this nominally normal anteflexion disappears at the time of complete puberty, adopting the theory of Rouget that the uterus is an erectile organ. This is a point at which much conflict of opinions prevails; some maintaining that during menstruation this normal anteflexion is increased by turgescence of the blood-vessels; and that this form of development prevails until the occurrence of the first pregnancy.

The weight of facts as yet observed shows that, whatever may be the cause, an anteflexed form is the rule in the incomplete state of the organ, which it is not unreasonable to suppose may be prolonged into the adult uterus, or at least, cast a certain and normal influence on its future form and position. The rarity of primary retroflexion—congenital so called—in the adult may be explained by its rarity in the puerile state.

(*b*). The evidence regarding the normality of the forward position and curve is nearly all obtained from the living subject. The antecedent condition of the uterus is supposed to exert considerable influence on anteflexions. Bennet and a few others hold to the view that this position is usually confined to the nulliparous organ; Martin, in the same condition of the uterus, while not distinctly claiming an anteflexed position, says that the anterior wall may be felt by the exploring finger through the anterior vaginal vault, with the subject upon her back, provided no pressure is exerted upon the abdomen. Subsequent to this statement, Martin came to the conclusion that in examining a women either upon her back, side or erect,

the cervix is found directed to the hollow of the sacrum. Hueter points the cervix against the perineum or coccyx. B. S. Schultze reasons that, as in nulliparæ the circumference of the upper cervical section of the uterus is considerably less and more flexible, and the vagina more firm than in those who have born children, the position of the organ is necessarily that of anteflexion; while in the latter, from the reverse of these conditions, version is more generally observed.

In 1853, Boulard, by the examination of 107 dead subjects, came to the conclusion that a slight degree of anteflexion was to be considered the normal position of the virgin uterus. This conclusion had a marked effect upon the opinion of observers. Many who had formerly held that the uterus had no relatively fixed position, among whom were Vermeuil, Gosselin, Aran, Cazeaux, Bennet and Tilt, sanctioned the statement of Boulard. It will be observed, further, that this conclusion differs materially from that reached by others who have reasoned from facts obtained exclusively from the cadaver.

The axis of the pelvic cavity affords a fair measure of the relative position of the uterus, and has been used by many, without, however, giving unanimity in the results. Martin says that the conclusion of Velpeau, Malgaigne, Valleix, Becquerel, and many others, that the unimpregnated uterus lies in the axis of the pelvic entrance, has less exceptional value than the statement of Herrgott that the organ does not lie in the principal axis of the pelvis, but behind it, the point of the cervix being 1 to 2 cm. before the connection of the sacrum with the coccyx, and the fundus for the most part 3 cm. below the pelvic entrance. Most authors place the fundus a few centimetres lower (Martin). Sappey's measurement, however, is 2 to 2.5 cm. Hennig found that the long axis of the body of the erect woman falls behind the fundus, cuts the cavity of the organ, passes close to the forward curvature, and again passes through the organ between the body and the neck. The results obtained by Hennig very justly gained no adherents. It needs but a slight study to show that such a section of the uterus by the axis of the body requires either a double flexion or an anterior flexion of the cervix at very nearly a right angle. Averard expresses the more generally received opinion by the statement that, when the woman stands

erect, the long axis of the uterus, when in the normal position, forms an angle with the horizon of 75°. Hueter holds as correct that the long axis of the uterus lies nearly in the axis of the strait, "or, if one wishes to be more precise, the axis of the organ lies somewhat behind that of the pelvis, but parallel to it." This may be regarded as the classical position of the text-books. Good types of it are to be seen in the illustration of Hodge and Sims. The illustration of Kohlrausch, which has had a marked effect on the minds of writers, shows the same harmony between the axis of the uterus and pelvic cavity, but not in the same offensive degree. All of these various measurements and angles are but another way of expressing in mathematical language the opinions of the writers that the anteverted and anteflexed position of the uterus is its normal attitude. Even when perfect coincidence is claimed between the two axes, the anterior position of the organ is well defined by the expression, since the axis of the pelvis defines an arc the radius of which terminates anteriorly to the pelvic cavity.

Mathematically the anterior position of the organ is well expressed by the authors who have observed the angle formed between the vagina and the uterus. Martin states this angle at 155° forward. This, with which many agree, conforms very nearly to the classical idea of position. The anterior angle formed by the body of the uterus with the neck is placed by Scanzoni at 140°, by Rokitansky at 165°, with which statement Martin agrees. Concerning these angles Hueter very justly remarks that no practical value attaches to them, and that in the living woman it cannot be established whether, in the normal form and position, the uterus in its long diameter corresponds with the axis of the pelvis, or what value the angle between the long axis of the uterus and vagina may have. However precisely these values may be stated, they are only approximately true. They are of service, however, as giving a clear idea of the extent of anterior position, held by careful observers as normally existing.

Penas examined 114 women in the Hospital Lourcine at Paris, the majority admitted on account of venereal diseases. Of this number, 44 were observed in whom the uterus was perfectly erect, and in 52 anteverted or flexed; while only in 6

cases was the backward position observed. Martin, who severely criticises both the method of observation and the results obtained by Penas, in order to test these results, gives the position noted in 8,528 women examined in his clinic; in 3,201 of whom neither version nor flexion, backward or forward, was observed; 2,325 were found to suffer from anterior or posterior displacements. The first group Martin regards as normal; while of the latter he observes that these "numbers do not appear as the regular and normal position, especially when we consider that those who sought help were sick." Credé is pronounced in his opinion that anteflexion and -version are the normal positions of the organ, and remarks that only in the higher degrees of anteflexion, where the flexion causes essential obstruction, is mechanical treatment necessary. Martin takes Credé to task for this statement. He can be understood, however, only from the context of his article, admitting, in general terms, a forward displacement of the fundus uteri, as observed by the bi-manual touch, and quoting approvingly the statement of Hennig already noticed. Schultze and Schröder, while at variance as to the details, agree in assigning the normal uterus an anteflexed position.

It is difficult to conceive how it is possible to have any doubt of the normal character of the anterior position of the uterus. The difference among authors as to the normal existence of anteflexion disappears when we take into consideration that the term by many is used relatively and not with a specific meaning. There is no author who has represented his views graphically, who has defined his idea of a normal anteflexion by representing an angle, mathematically so called, at the junction of the uterine body with the uterine neck. These normal angles are all curves of longer or shorter radii. Under this view, the objections of many who are opponents of the normal anteflexion theory disappear. It is difficult to convey a well-defined idea by the use of a term applied, without any qualification, alike to conditions of health and disease. An angle of 165° in an elastic organ like the uterus defines a curve, not an angle. It is only by an exercise of the scientific imagination that it can be made to conform to the mathematical idea of an angle. Scanzoni, by the above-estimated normal angle, abandoned all precision in the use of his terms. He conformed,

however, to the usual expression among gynecologists when defining the normal position of the uterus. The idea conveyed by Scanzoni can be more definitely expressed when describing short lines of six or seven centimetres, and this line existing in an elastic mass like the uterus, by stating that the organ describes an anterior curve of 15 centimetres radius. In abandoning the term flexion when describing the normal position of the organ, we leave behind us nearly all the debatable ground in the matter of the normal position; and by substituting for it the term curvature as defined by its radius, we express more accurately the normal condition of the parts.

(*c*). The literature concerning the normality of the vertical or backward position of the uterus is scanty and unsatisfactory. "Simple retroversion," remarks Goupil—and without this state of simplicity the possibility of a normal condition is doubtful—"whether in nulliparæ or multiparæ, is so rare that it may be said to exist only as a symptom of some other condition." In 115 nulliparæ examined by him at the Lourcine Hospital, there were only 3 cases of this character, none of them normal. In the same total of cases he found the organ straight in 19. The difference in observers is well illustrated by the fact that of 50 nulliparæ examined by Depaul, the uterus was found "straight" in 32 cases. Gosselin nearly verifies the results of Depaul, having found this state of the organ in 18 out of 45 cases. The only possible normal retroversion that Martin admits is the physiological one of the second month of pregnancy. Claudius, gaining his knowledge from the dead subject, declared his belief that the uterus is found normally with its posterior surface lying close to the posterior pelvic wall, as the lungs lie against the ribs, and that in the sexually healthy woman the uterus rests immovable in the pelvis. Yet the opinion of Claudius finds supporters even at this day; Holstein indorsed it in 1874 in an inaugural thesis. Hueter holds to the opinion that the most frequent position of the uterus is one nearer the sacrum than the pubes. Martin, in a posthumous paper published by his son, modifies the views advanced in the opening chapter of his book on flexions. He says, "When the index finger is introduced without force into the vagina, the cervix is forced to the side, or displaced backward or forward, without inducing any pain, but

not reaching the uterine body at any point near the vaginal part." Such a position could only be detected by the finger when the organ is erect. It follows then, that towards the end of his career this observer held that the nearly straight or erect organ was ideally correct.

Lazarewitsch states that the uterus is situated behind the "middle line" of the pelvic canal, the uterine body not being perceptible to the touch either through the anterior or posterior vaginal vault, provided the uterine body is not forced down by pressure on the hypogastrium.

The position of the uterus with reference to the pelvic outlet, or its position relative to the vaginal depth solely, must necessarily throw considerable light upon the forward or backward position of the normally mobile uterus. Conceiving the uterus in a position of so-called normal anteversion, it is evident that, if it descends in the pelvic cavity, its cervix following the concavity of the sacrum and coccyx, the fundus of the descending organ passes backward, while the cervical portion undergoes a corresponding movement forward. In this way we can conceive of a normally erect organ, presuming a movement of descent within a limit of health. Upon this question all measurements of the distance of the cervix uteri from the perineum or external soft parts have a partial bearing. Martin, with a point of departure from the end of the coccyx, places it at 1.5 to 3 cm. Aran says, "L'utérus ne repose pas sur le plancher du bassin. Il en est séparé par un intervalle, qui est ordinairement de 2 cm. et s'élève rarement jusqu'à 3 cm." In those who have not born children and in girls the cervix is from 7 to 8 cm. above the ostium vaginæ (orifice de la vulve), and in those who have born children it stands at an elevation of 6 cm. Lazarewitsch states the least distance at 6 cm. These measurements have but little practical value, owing to the extreme mobility of the outer soft parts. These distances, however, place the uterus sufficiently high to give the organ an anterior position parallel to the forward curvature of the middle part of the sacrum. Under these conditions it is conceivable that, if the uterus were to hold normally a straight or vertical position, it would depend upon forces not resident in the uterus, but foreign to it, and to what is theoretically conceived to be the normal operation of its direct supports.

At the proper place we shall be able to prove that the uterus cannot be assumed to have a fixed distance from either the point of the sacrum or the external soft parts that holds true to either the mass of women or to an individual.

(*d*). The statements of authors as to the position of the uterus in the dead subject are worth a short notice. While a few facts of great importance may be derived from this source, yet great caution must be exercised in drawing conclusions from them.

Henle says, "that to judge of the position of the organ in the dead body, one must have regard to the conditions under which it is found; that to himself it is doubtful whether at the conclusion of death, the relation of the parts to the living are the same." Figure 330 in his "Handbuch der systematischen Anatomie des Menschen" is a good illustration of the character of figure a strict copy of the actual pelvic section will afford. The organ is represented in a position of strong retroversion. In gynecological investigations the conditions are unfavorable to a correct knowledge. The parts are generally examined in an empty condition of the bladder and rectum, from which circumstance the position has to be estimated (Schultze); the same exercise of deduction must be resorted to, in using the facts furnished by the pelvic section. In death the firmness of the uterus and its neighboring parts changes, but in the fresh cadaver, long before the firmness and elasticity of the connective-tissue supports are lost, the uterus by its weight alone falls backward, to which may be added the gravitation of the intestines in the same direction, which seems a sufficient explanation of the fact that a pelvic section in the dorsal position always shows the organ in a state of retroversion (Schultze, Henle). The inference is natural that, in the living women, the usually found anteverted position of the uterus in an empty condition of the bladder is due to muscular action. There is scarcely an exception to this backward position of the uterus in the representation of the pelvic section; the ovaries and the broad ligaments are also represented as sharing in the movement (Pirogoff, Le Gendre, Tüngel). All authors agree that this is a post-mortem change; nor is it necessary that the parts should be exposed to a prolonged operation of the force of the death-changes in order to

show this position. Claudius is the only exception among authors who has reasoned directly from the dead to the living, without giving due value to the effect of death as a factor in the post-mortem movements of the organ. Schröder, who gives intra-abdominal pressure great value as an agent in securing the uterus in position in the living woman, explains the after-death position of the organ by its absence, and also to the development of gas in the intestines during the death struggle. The absorption of intercellular tissue may also have a certain value, if not in the direct causation, in permitting free movement within the pelvis (Israel).

Schultze is the only one among the authors quoted who seems to recognize the importance of the action of the uterine ligaments in this post-mortem position. To ascribe such an important and uniform change to the force of gravity alone is to overlook what is inferentially a fact, that vital action plays an important role in the phenomenon of uterine position in the living.

No uniformity prevails among authors who have illustrated their ideals of uterine position graphically; and as a consequence much controversy has been carried on concerning the correctness of these different illustrations. As we shall see, there is a wide scope for difference in the details of such an illustration while the central figure approximates the truth. The warm controversy between Schröder and Schultze about the correctness of their pictures of uterine position originated in the error in which both authors were involved, that it is possible to do more than portray an ideal position. To represent the actual position of the unimpregnated uterus is impossible. An artist, when he represents a carriage wheel in motion, does not depict any spokes at all; and equally so, since it is impossible to represent the uterus as a fixed organ, it cannot be given any one position, within a certain normal range, that does more than approximate its true place.

The figures of authors illustrating this important point of gynecic science may be divided into two groups; one aiming to give an ideal of the position of the organs within the living female pelvis, and the other striving after absolute realism. Types of the first, which we have called the classical position, are found in the works of Kohlrausch, Marion Sims, and Hodge.

The essentials of these figures are a distended rectum and bladder, with the uterus lying between them very nearly in the long axis, parallel to that of the pelvic cavity. The slight difference being that, in the first author's figure, the virgin uterus is represented, and in the two latter that of the child-bearing woman. These figures, particularly that of Kohlrausch, have furnished the material for illustration in nearly every text-book for the last twenty years. In reality nothing can be farther from the truth. They take for granted a nearly impossible conjunction of circumstances, namely, an equal and uniform distention of bladder and rectum, which might not occur once in the lifetime of the subject; and further, equal value is assigned to the bladder and rectum in influencing uterine position and movement, when in reality they play vastly different parts in the dynamics of the pelvic organs.

The second group of illustrations is more interesting. These figures deserve a brief description, as showing the difficulties in the way of reaching what is styled by modern art a realized ideal in this matter of uterine position. The more recent attempts are those of Schultze and Schröder, upon whom the interest centres. Schultze's criticisms upon the figure of the latter are in the main well deserved. Thus the cervix is too near the anterior pelvic wall, as if forced forward by a retro-uterine tumor; the fundus is placed above the superior strait, and as if to exaggerate the error, the soft parts are made to extend so far beyond the pelvic outlet that a line drawn from the lower border of the pubes to the point of the coccyx bisects the uterine neck, the organ being yet represented at a proper depth within the vagina; while the forward displacement of the cervix produces an enormous Douglas sac, really placing that cavity between the rectum and vagina. It is remarkable that Schröder places part of the uterus and nearly all of both rectum and vagina external to the pelvis. On the other hand, Schröder remarks of Schultze's figure, as an indirect defence of his own, that his theory of an inconstant angle at the union of the body with the neck, dependent on the varying degrees of vesical fulness, is a gross error, justly remarking that slight outward force can change the position, but considerable force is necessary to change the form of the organ. Concerning the great protrusion of the soft part in his

illustration, he defends himself by an appeal to the drawings of the pelvic sections of Braune and Rüdinger in connection with numerous measurements of his own, by which he shows that Schultze very much underestimates the extent of the external parts, the result of which is that the os uteri in his drawing is placed too near the ostium vaginæ, which is found in practice only as the result of pelvic tumors. Schröder is supported in giving this position to the soft parts by Friedrich Hach, who, in a very recent monograph, places nearly the entire vagina external to the pubo-coccygeal pelvic diameter, and also gives the passage a very nearly horizontal direction. It is interesting to note that, as a result of the manipulation practised nearly exclusively by the gynecologist, namely the bi-manual touch, Schultze places the long axis of the uterus at nearly a right angle to that of the body; a position never given to the organ by the anatomist, and one also that the average practitioner would treat as abnormal.

This review of the abnormal position of the uterus given by various authors concludes the first part of the evidence. But we have yet before us a more important study; that of the range and cause of normal uterine movements, and which, in a great measure, turns upon the connection of the uterus with its neighboring organs, and its more direct means of support.

B. Anatomical and Physiological Evidence.

We have here three principal divisions to consider.

(*a*). The self-sustaining power that exists inherently in the uterus.

(*b*). The extent and cause of the normal movement of the uterus.

(*c*). The agents that limit or retard the normal movements, the so-called uterine supports.

(*a*). While it is admitted by general authority that the uterus has existent in its tissue qualities that tend to render the organ in a measure self-sustaining, there is some difference of opinion as to the tissues that possess these qualities. The most widely diffused theory is that of Rokitansky. According to this view, there exists a firm sub-mucous stroma of connective tissue, which is thin at the os internum, thicker at the

fundus uteri, and yet more freely developed in the posterior wall, and which, by being prolonged into the vaginal portion, contributes to the thickness, firmness, and density of the mucous membrane of that part. This stroma is, so to speak, the scaffolding of the uterus and the cause of its upright position. Rokitansky's great rival Virchow enters the field with a counter theory, for which he contends as ardently as if he were defending a theological dogma. He asserts that the layers of the mucous lining of the uterus in no manner contribute to the support of the organ; that the mucous membrane at the cervix is relatively thin, and in the body of the organ yet thinner; that, instead of being dense and firm, it is very rich in cells, and comparable more to granulations than to the dense structure of connective tissue; that the real support of the organ is the parenchyma, which, in the body of the organ, is rich in muscular fibres and vessels, and, in the cervix, appears more abundantly supplied with fibrous connective tissue. It is impossible to reconcile these different views. They exist among uterine pathologists at the present time with the force of facts, while in reality they have simply the force of opinion. Rokitansky's sub-mucous connective-tissue layer bears the hypothetical relation to his theory that the imaginary ether does to the undulatory theory of light; but while a hypothetical ether is essential to the explanation of such a material as light, physical science would reject a like basis for a theory relating to an organ that one may take into his hand and demonstrate its parts. The theory of Virchow, as the more direct outcome of absolute facts, deserves more consideration than that of his rival. But for the reason that both theories are dogmatic, they deserve rejection in the shape in which they come from their respective authors. Both strikingly illustrate the evil effect of authority when it is expended in propounding rival theories instead of seeking truth. Independent thinkers in gynecology take the middle ground; but as explaining all that Rokitansky and Virchow claim for their theories, both are wrong. Even admitting the existence of the former author's theoretical sub-mucous connective-tissue stroma, it could not explain all the phenomena of uterine normal and abnormal position. The purely gynecological view is different. Martin regards the uterine connective tissue as acting an important part in aiding

the uterus to maintain its place, but does not limit it to any one layer. Hueter places great stress on the almost perfect equality in the thickness of the anterior and posterior walls as a means of preserving an equal balance in uterine position. In quarters in which the opinion of Rokitansky and Virchow have not produced undue effect, the opinions of gynecologists, so far as expressed, coincide with the above.

Practically, this power of self-sustentation, since we cannot isolate it from other factors in the phenomenon, is of sufficient force to bear the weight of the superincumbent viscera and to preserve a certain alignment between the body and neck of the organ, in opposition to the force of gravity; and, lastly, to preserve the form while the uterus is shifting its position under the operation of its neighboring viscera. If under this last-named circumstance the uterus changes its form materially instead of its direction, it answers to the condition of a morbidly mobile organ (Schultze)—a state occasionally found in practice, and usually the result of defective evolution, or of more recent pathological changes in the parenchyma of the uterus. It was the study of these two conditions that probably led Rokitansky to devise his submucous connective-tissue theory.

(*b*). The study of the extent and cause of the normal movements of the uterus is difficult and complicated. In view of these movements, we cannot regard the pelvic cavity otherwise than as an area in which force and counterforce are contending. The forces that produce these movements are partly voluntary and partly unavoidable and involuntary. Such a classification as this is, however, arbitrary. These forces merge one into the other. A uterine movement that, within a certain limit, is an expression of involuntary force, may, if prolonged beyond this limit, express the action of a voluntary force. An illustration of this is to be seen in the uterine movements attending normal respiration, and the movements of the same character, but more extended range, that proceed from voluntary forced inspiration. Many other movements afford examples of the same fact.

Authors generally recognize the mobility of the normal uterus, but differ as to the range. Hueter gives to the organ more frequent and greater movement in the direction of its long diameter. In this direction it is usually voluntary, from

the effect of movements of the diaphragm and strong bodily action. On pushing the organ upward by the finger, it quickly returns from the action of the abdominal muscles and viscera. This author characterizes the statement of Rockwitz as absurd, that he is able to raise the uterus to the height of the umbilicus. Hyrtl states that it may be forced upward two inches, and depressed one inch without encountering any special resistance. Säxinger says that by means of the sound the uterus may be raised two inches without causing the woman any pain. When the vagina is relaxed and the ligaments extensible, the uterus may be drawn downward until the cervical portion presents at the ostium vaginæ; but this is not always to be regarded as a safe operation (Hueter), and, as we learn from Savage, the sacro-uterine ligaments may be lacerated when the uterus is drawn down to that extent. On the other hand, Martin, while admitting uterine mobility, dissents from the statement of Hyrtl, and says that he has never been able to cause such a range of movement. M. Claudius holds that uterine movement is limited by the flexibility of the neck, and the same author has elsewhere stated that the uterus lies immovable against the posterior wall. Avrard (de la Rochelle) regards the chief uterine movements as existing with reference to a determinate position, from which it may be pushed by the exploring finger, and to which it quickly returns on the withdrawal of the displacing force. A movement which some authors would regard as normal Martin defines as abnormal. Such, for instance, as a considerable displacement of the organ caused by the pressure of the finger in the vagina.

In order to understand fully the grounds upon which we shall base our conclusions as to the normal position of the uterus, it is important to carefully analyze the cause and effect of the various forces which operate within the pelvic cavity. As the result of all these forces is to produce uterine movements, we are able to classify them to better advantage as causes rather than effects.

(α.) Respiration and abdominal forces causing uterine movement.

(β.) Effect of posture on the position of the uterus.

(γ.) Vibratory movements.

(δ.) Effect of varying degress of vesical fulness.

(ε.) Effect of rectal distention and collapse on uterine movement.

In a work undertaken as a preliminary to this investigation, in the year 1874, and published the next year, upon uterine movements, I succeeded in proving the character and extent of the movements, and also in representing them graphically by means of a recording mercurial manometer. As I have seen nothing since so full and complete upon this interesting subject, I shall to a great extent draw upon that paper for the material used here.

(α.) While insignificant in their normal range and having but slight, if any, value in causing pathological results, yet the movements of the uterus due to the respiratory movements of the diaphragm become of importance when we apply to the uterus mechanical means to correct its dislocations. The uterine movements attending respiration, as represented by the tracings of the recording manometer, are of a simple character. The downward part of the curve records the inspiratory pressure. The character of the respiration, so far as it is rapid, slow, or forced, does not change the curvilinear nature of the tracing. The spaces between the summits of the curves express the expiration pauses. The inspiration pause is so short as to permit the uterus to ascend almost immediately, thus giving the tracing a short lower and a lengthened upper curve.

During articulation, the uterus is subjected to a series of rapid movements. The character of the curve taken during conversation is that of ordinary respiration of somewhat greater amplitude, with its ascending and descending curves interrupted by numerous sharp notches, which correspond to articulate words. Some acts which involve the use of the respiratory organs produced marked uterine movement. The full-chest inspiration necessary in holding the voice while singing prolonged notes induces a sudden extended downward movement, gradually returning to its initial point. This movement may account for the frequency with which uterine displacements, and usually those which indicate a lack of sustaining force, are met with among professional singers. In coughing, a considerable movement of the uterus occurs, the tracing of which represents a rapid series of acute curves with a nearly uniform

notch near the lower angle, and which is usually found in tracing in which the uterus has reached the limit of elasticity in its supports, and there is a disposition on the part of the organ to return to a position of equilibrium, which is resisted by a continuance of the displacing force.

But few of the authors speak of these movements. Hueter gives them incidental mention and no importance, except to those which attend sneezing and coughing. Frankenhäuser says that in easy breathing with costal motion the movement of the uterus is not very noticeable; while Martin strangely confines all the movements attending the various states of the respiratory apparatus to the vaginal portion of the uterus, which he says is forced downward and forward. It is not easy to understand how a force, acting upon the general contents of the pelvic cavity, could, so far as it affects the uterus, be confined to the neck of the organ. In estimating the effect of abdominal pressure upon uterine movements, it is not an easy matter to eliminate the extent to which the respiratory organs are involved. In voluntary straining or bearing down, for instance, the diaphragm, held fixed by a retained full inspiration, becomes the counter force, while the abdominal muscles contract and force downward the pelvic viscera. The tracings of uterine movements so caused are simply upward and downward movements of the recording pen of great amplitude, involving a corresponding downward displacement of the uterus of half to three-quarters of an inch. These movements become of importance chiefly because of the great power that can be exerted during this act; and which must play a certain part in the dynamics of abnormal uterine movements. In the experiments to which we referred, this force was found to measure, by the mercurial manometer, from one to six pounds. If we regard the opinion expressed by Poppel and Duncan, that the force expended in an easy labor is from four to six pounds, as at all correct, the remarkable fact is forced upon us that there exists in the average woman—non-pregnant—voluntary expulsive force equivalent to an easy labor, and which she is capable of exerting at will. It is evident, therefore, that these movements, as the result of a force existing potentially behind them, are of great importance, not only in a normal, but in a pathological study of uterine mobility. But while the action of the

abdominal muscles are capable of exerting so great a force in the direction of uterine displacements, authors (Schultze) may be named who regard the intra-abdominal pressure as one of the factors in sustaining the uterus in its so-called normal position, and especially that of anteflexion.

(*β.*) Like the group of movements already considered, those due to posture, when within a normal limit, are not of considerable extent, and yet a study of them is indispensable to careful estimate of uterine position. The most elaborate investigations of the effects of bodily position on uterine movement are those of Dr. J. H. Aveling, of London. Considering the results he reaches in normal changes of position due to this cause, we find the uterus descending in the pelvic cavity to but a very slight extent. Ascension, when in the recumbent posture "the pelvis is tilted over the uterus, relieved from the pressure of the abdominal viscera, gravitates away from the vulva, and in this way, as has been already shown, any uterine depression which may have have taken place during the day is remedied at night." Anteversion (antrorsion) in mean normal relation may be increased by an inclination of the body forward, easily augmented, according to the author, into an abnormal degree; especially when uterine enlargement exists as a factor in the movement. Retroversion (retrorsion) may result from the erect position, from long recumbency, but in the normal condition of the parts it is an insignificant change in position. Torsions (dextrorsion and sintrorsion) are rarely, if ever, normal movements. Dr. Aveling regards dextrorsion to a certain extent a normal change, caused mainly by women sleeping upon that side.

Bernutz and Goupil make the difference in uterine position between standing and lying as follows: the posterior cul de sac to the "vaginal orifice" is eight millimetres longer, from the os uteri eight millimetres, while the anterior cul-de-sac is represented fifteen shorter while lying. In another figure the anterior cul-de-sac is seven shorter, the posterior unchanged and from the cervix nine millimetres longer in the recumbent posture.

The measurements were roughly taken by marks upon the exploring finger and cannot be regarded as furnishing more than an approximation to the real variation of uterine position due to the change in posture. According to Schultze a passive

movement backward due to the gravitation of the uterus is common in the dead subject, but is rarely met with in the living. He states, however, that in the erect position the uterus gravitates forward, this tendency being further assisted by the intra-abdominal pressure. The inference that the reverse occurs when the person is in the dorsal position is legitimate. Avrard states that when the woman is erect, the uterus in the normal position forms an angle with the horizon of 75°, but Hueter objects to this on the ground that with every movement of the body the uterus is changing its position. Martin, in his writings edited by his son, says in general terms, as the result of careful observation, "that a marked difference in the position of the organ in the erect posture, or the dorsal or lateral decubitus does not exist, unless an unusual mobility of the uterus be present."[1]

In the contribution to this subject made by the writer and already referred to, tracings of considerable interest were obtained of uterine movement due to postural changes. The tracings of these movements express the following variations in the distal column of the manometer: (1.) A sudden rise on sitting up from the zero position (lying upon the back); (2.) a slight further rise on standing up; (3.) a vibration movement when stepping upon the floor; (4.) a sudden rise of five to eight-tenths of an inch upon squatting; or (5.) a slight descent upon bending forward; (6.) a quick but tremulous ascent on resuming the standing position; (7.) a slight fall upon sitting down; (8.) a return to zero upon lying down. The tracing, therefore, records the varying amount of pressure upon the uterus during the postural changes described. This observation points clearly to what occurs in the pelvis. In lying down, the pressure is *nil;* in sitting the visceral gravity is expended partly upon the pelvic organs and partly upon the lower portion of the abdominal wall in front; in standing, the anterior wall of the abdomen becomes more perpendicular to the plane of the pelvic excavation, the pressure is reflected off the abdominal wall

[1] "Dass ein wesentlicher Unterschied in der Lage des Organs bei der aufrecht stehenden, wie bei der auf dem Rücken oder auf einer Seite liegenden Frau nicht stattfinde, wenn eine mehr als gewöhnliche Beweglichkeit nicht besteht."

downward in the line of the pelvic axis; in squatting, the weight of the viscera is thrown upon and above the pubes, and the pressure taken off the pelvic organs, consequently the uterus rises in the pelvic cavity, the fundus turning forward and the neck backward. The absolute uterine movement corresponding to the abscissa of the curves in these tracings is from .5 to .8 of an inch altitude.

(γ.) The vibration movements, while of but little importance in a study of uterine position, become of considerable value as giving a clue to an important and but little understood factor in uterine support. They deserve, therefore, a brief consideration. As the only observations upon these movements were made in connection with the above experiments, we again quote from that paper. In nearly all uterine movements, except in those due to movements of the diaphragm, there is a marked vibration movement apparent in the tracing. This becomes a leading feature in the record of walking movements. Mainly a walking curve results from motion in the mercury of the manometer something like this: As the foot touches the floor in advancing, there is a slight upward movement in the distal side of the instrument equivalent to a descent of the womb; as the opposite foot is raised and advanced, there is a descent in the mercury corresponding to an ascent of the organ. These two movements form the main features of the tracing. But the curve is complicted by angular irregularities, which I cannot explain except that they are due to vibrations. They are more numerous in the upper portion of the tracing which corresponds to the position of equilibrium of the uterus. This coincides with the most reasonable idea of their origin, for it is at the point of least tension that vibrations would naturally take place. Uterine vibration movements are of great variety of extent, some of them nearly equalling the almost perpendicular markings attending the rise and fall of the feet. It is evident that the connective tissue supports are involved in this movement, as will be further established when speaking of uterine supports.

(δ.) The influence of the varying conditions of the bladder upon uterine movement is a much debated matter. To what-

ever extent the bladder may affect the position of its fellow-organ, it is dependent upon two conditions: (1) vesico-uterine connection, and (2) displacement. The first is maintained by means of the utero-vaginal cellular processes which are extensions of the cellular layer in the vesico-vaginal septum (Savage), and the pelvic reflections of the peritoneum. Carrying our investigations further into the nature of this cellular connection, we learn that it is of very loose structure, made up of strong connective tissue fibres (Pausch); and that the extent of this connection is quite limited, since the upper two-thirds of the uterus is covered by peritoneum that is reflected from the bladder, while of the remaining one-third, but the portio supravaginalis, makes direct connection with the bladder (Hueter). The importance of this vesico-uterine connection is evident from the experiments of Mäunel on the dead subject, who found that, on severing the connection, but a slight force was necessary to dislocate the uterus on the posterior pelvic wall. The extent to which the excavatio vesico-uterina and the fossa paravesicalis exist as actual cavities is under dispute. Some authors describe them as absolute fossæ (Martin, Hueter, Hasse), while really they are relative and dependent on the state of vesical fulness. Savage is undoubtedly right when he says that, where the bladder is "fully contracted, the peritoneal covering is scarcely raised, and forms neither a vesico-pubic nor vesico-uterine fold; these make their appearance only when the upper surface of the bladder rises." On anatomical grounds, then, it is evident that the varying extent of the bladder must exert a considerable influence on the position of the unimpregnated uterus.

Among authors, however, there it a great difference of opinion as to the actual limit of this influence. Martin would restrict the action of the bladder to very large accumulation of urine, and confines the displacing force to the vaginal portion of the uterus, and during the expulsion of urine the cervix moves downward and forward while the bladder is being partially emptied, and then remains stationary during the completion of the process. He dissents emphatically from the statement of Schultze, that in an empty state of the bladder the bi-manual touch shows the uterus to form a right angle to the

body. Martin's position is partially sustained by the experiments of Le Gendre on the frozen pelvic section, by which it was shown that the uterus was but slightly pressed backward. It must be observed, however, that its anterior displacement is probably greater in an empty condition of the bladder than in the opposite direction from distention. Hueter admits a normal displacement of 25° to 30° from this cause; while Hasse takes the extreme ground, that bladder distention so forces back the uterus that the intestines are driven out of the Douglas space and admitted into the excavatio vesico-uterina. Aveling gives the bladder great influence as a pathological factor in retroversions; and Schröder believes that in congenital anteflexion and retroflexion the form of the uterus is not attended by the state of the bladder, while with the normal angle it is but slightly affected. Contrary to the opinion of Martin, he limits the uterine movement to the fundus of the organ, the cervix not following the movement to a corresponding degree during the ascent of the bladder wall, and the more flexible the uterus is in the region of the cervix, and the firmer the vagina, the more flexion in a normal manner succeeds anteversion.

The author who has given this interesting question the most careful study is Schultze, and who finds in bladder connection and movement the key to the normal anterior position of the uterus. He regards it as established that, in normal and abnormal positions of the uterus, prolapsus, and forward and backward displacement, the posterior wall of the bladder follows the uterus, "a relation so constant that it may be concluded to exist in every case." "I have," he continues, "established as a matter of fact that, in emptying the bladder, the uterus becomes anteverted or anteflexed, for which I have sought an explanation. The fact is, that when the woman is lying upon the back with the bladder full, we find the uterus in the position represented by Kohlrausch, when we empty the bladder with the catheter—the position of the woman being unchanged—we find the uterus completely anteverted or flexed, contrary to the operation of its own weight. In the upright position the intra-abdominal pressure is increased, and presses the corpus uteri yet further in its existing anteverted

position." In another article, the author states that the inference is natural that, in the living woman, the force which tends to restore the uterus to a normal position of anteverted flexion, after evacuation of the bladder, is muscular action.

(ε.) The condition of the rectum has less marked effect on uterine movement. The first influence exerted by it upon the uterus is the permanent one due to the usual position of the intestine to the left of the sacrum (Savage); this position leads Prof. Hasse to the conclusion that the uterus is displaced forward, the fundus is somewhat pressed to the right, and thus the long axis of the organ lies obliquely directed forward, and to the right superiorly, and behind and to the left inferiorly. Of course, this obliquity is very slight under any circumstances, and not more than appreciable in a distended state of the rectum. A direct forward displacement of the fundus from rectal distention is more marked, and Martin even gives it pathological significance. From the normal physiological state of the rectum he infers the following movement in the uterus. The movement is inversely that due to the bladder, the organ is pressed forward, somewhat anteverted, and through the stretching of the lig. sacro-uterina slightly elevated. Others are of the opinion that this usual movement is to the right and forward—an anteversion (Piachaud, Cusco), while Hueter regards uterine movement from this cause as so slight as not to merit much attention.

(ζ.) In the ligaments of the uterus—if we regard them in a measure as antagonistic in their office—we must look for a twofold action: (1.) the first as a means of support, or as inhibitory to uterine movement, and (2.) as a cause of motion.

Before turning our attention to the ligaments, it will serve a useful purpose to examine into a somewhat disputed matter, namely:

(1.) The presence and effect of intestines in the Douglas space. It may be regarded as a fact that, in considerable expansions of the rectum and bladder, the extent of uterine surface exposed to the contact of the small intestines is more limited than in the empty state of those organs; and as the posterior wall of the uterus shows a much larger expansion covered by peritoneum than the anterior, it is apparent that the posterior

wall is more completely enveloped by links of small intestines than the opposite surface. The views of Claudius, that the uterus with the broad ligaments and the ovaries lie against the posterior wall of the pelvis, leads him to the conclusion that in the normal condition loops of intestines are never found between the uterus and the posterior pelvic wall, and in which statement he is supported by Pirogoff, Le Gendre, and Tungel (Martin). Pirogoff, in his work, "Anatomia topographica sectionibus per corpus humanum congelatum illustrata. Petropoli, 1859," Fasc. III., Tab. 30, Fig. 13, gives an illustration in which loops of intestines are represented between the uterine fundus and the sacrum. At the same time he remarks in text, p. 90: "Saccus cæcus plicæ peritonæi recto-uterinæ ansam intesteni contenens." Israel explains the presence of the intestines in the Douglas space, in the illustration of Pirogoff, as being due to the effect of emaciation, which explanation is adopted by Hueter. The latter claims that the absence of intestines in the recto-uterine cul-de-sac is in general undisputed. "If it were," he observes, "a frequent occurrence that the small intestines occupied the posterior cul-de-sac, the finger in exploring the vagina ought to detect the sound of intestines behind the vaginal portion, a condition that the author never observed."

On the other hand, Prof. Hasse states that, in the erect position of the woman, the intestines are always present in that situation, and are expelled by the fundus uteri gravitating backward when the woman lies upon the back. Schröder states that the intestines are present under all positions, and are driven out after death by distention with gas, and thus permits the fundus to drop backward. Schultze gives considerable importance to this in the study of pelvic dynamics. The presence or absence of the intestines in this situation is the result of law and not of accident, and that in the act of emptying the bladder or rectum the uterus and intestines move quickly, in order to fill the space thus made vacant. Therefore, the intestines are or are not present in the recto-uterine space, according to the varying states of vesical or rectal fulness.

The manner in which the intestines, either in the Douglas space or over the fundus, and anteriorly to it act as an agent

in sustaining the position of the uterus is evident. They present a means of obstruction to uterine movements that otherwise would be very liable to occur, and are thus prevented or retarded. Säxinger believes that one cause of the normal anteverted position of the uterus is due to the pressure of the intestines posterior to the organ. Martin states that the presence of the small intestines between the forward uterine wall and the bladder operate partly in pressing the ligamenta lata downward in the form of a concave bow on the wall of the pelvis, thus putting it upon the stretch, and securing the uterus against lateral movement. We may say, then, of the action of the intestines, that they tend to secure the uterus against sudden movement, passively and mechanically, and are therefore subsidiary to other and more active means of support.

(2.) Judging from its anatomical relations, the ligamenta rotunda have an important action in defining uterine position and movement. Prof. Lieberkühn, of Marburg, at the request of Martin, made a careful histological examination, the result of which he communicated to the latter. The ligaments are made up of smooth and striped muscular fibres with a connective-tissue envelope. The smooth fibres coalesce with the outer longitudinal layers of the uterus on the anterior and posterior part of the fundus; the striped fibres, beginning at an uncertain point, mingle with the smooth fibres, and are inserted at three points by tendonous and fleshy terminations: (1.) in the aponeuroses of the internal oblique close to the pubes; (2) on the upper and under sides of the outer ring; (3) the smooth fibres, after passing through the inguinal ring, are inserted a connective-tissue filaments in the connective tissue of the mons veneris, part separating and entering the periostium of the os pubis, and part to the fascia pectinea. It is supplied with blood-vessels and nerves. It is therefore histologically the most important of the ligaments. Martin alleges that these ligaments perform an active part in uterine movement by means of their striped muscular fibres. They raise the fundus of the uterus forward, drawing it toward the pubes, which act is supposed to be of importance in putting the uterus in a favorable position for the admission of semen in a fruitful coitus. Rainey alleges that at the third month of pregnancy their strength is increased to that of the little finger.

Hueter states that, after severing the round ligaments in the dead subject, the uterus remains fixed in its position, which is contrary to the opinion of their importance generally entertained. Their apparent effect is described by Klob. They permit, by their relaxation and contraction, in some measure, a rising and sinking of the uterus, and at the same time an approach of the fundus to the symphysis pubis, while a considerable escape of the fundus backward is opposed. But as these ligaments run in an upward and outward convex curve, the uterus may make a considerable change in position without drawing upon the ligaments until the curve is stretched. Nevertheless he holds that it is established that these ligaments assist in securing the uterus, and to be considered as "nichts als die blossen Reste der Gubernacula Hunteri." Hueter offers the suggestion that these ligaments are available as a means of support to the uterus, only so long as they are not stretched, believing, with the author last quoted, that when they are extended by the enlargement of the uterus from pregnancy, they never recover their former power of preventing extensive backward movements, or to lift the fundus forward.

The theoretical correctness of the above explanation was confirmed by Spiegelberg, who had an opportunity, in the year 1859, to examine the action of these parts under the effect of electrical stimulus in a young woman who was decapitated. The uterus and its annexes were placed in the circuit fifteen minutes after death; on passing the induced current directly through the uterus, the fundus was raised from the pubes, forcing the organ lower in the pelvis, and placing the round ligaments on the stretch, and then showed a tendency to draw the fundus forward.

We may conclude that in minor uterine movement these ligaments exert no inhibitory power, and that they exist as a sort of reserve support in the varying phases of the physiological evolution of the organ. In the unimpregnated uterus the function of these ligaments is brought into play only during excessive uterine dislocations, unless, as Martin suggests, they perform a part in the sexual act.

(3.) Of really less importance than any other uterine annex, so far as movement is concerned, are the broad liga-

ments; on this there is general agreement. These ligaments are furnished with numerous elastic and muscular fibres, which radiate over the superficial layers of the uterus from between the folds of the peritoneum (Rouget, Martin, Richet, Luschka). Martin believes that, so far as relates to uterine errors of position, these ligaments are not of great importance. Richet concludes, from the result of his experiments on the cadaver, that division of the broad ligaments promotes retroflexion. This is of value only in those cases in which the tissues of the uterus are greatly relaxed. Mannel, in his experiments on the cadaver, found that the uterus remained upright after division of these ligaments. Hueter states that the manifest contractions of the broad ligaments prevent, in a certain degree, departure of the uterus from the upright position to the right or left, and oppose but slight resistance to backward or forward movements.

(4.) The ligamenta pubo-vesico uterina (Hyrtl)—lig. utero-vesicalia, plicæ vesico-uterinæ—are small fold-like prominences of the peritoneum, which bound the shallow excavatio vesico-uterina, and are reinforced by means of fibrous processes (Klob) of pelvic connective tissue from the os pubis, and which, passing both sides of the bladder, are inserted in the uterus at the junction of the uterine body with the uterine neck. These ligaments are not very strong (Hueter). Luschka has found in them smooth muscular fibres which can be traced to the superficial layers of uterine muscular fibres. The evident action of these ligaments is to retard any considerable dislocation of the uterus backward, and at the same time any strong depression of the fundus forward. This is Hueter's view, but it is difficult to credit this action of the ligaments when we take into consideration the admitted point of insertion at the union of the cervix with the uterine body. The fundus is left free to undergo movements not participated in by the cervix, and, therefore, it is necessary to assume that the self-sustaining qualities of the uterus become a factor in the action of these ligaments described by Hueter. Theoretically, we may regard it as opposing forward depression of the fundus, by giving the uterus a certain degree of forward fixation, assuming a normal resistance of tissue at the isthmus uteri. Prof. Frankenhäuser regards these ligaments of great importance as uterine

supports; while Martin adopts the generally accepted view that they are of but little value.

(5.) The duplication of the peritoneum in the recto-uterine pouch gives occasion to small fold-like prominences of peritoneum which bound the space on every side. These folds are reinforced by means of fibrous processes of pelvic connective tissue (Klob), and which are described as passing from the sacrum on both sides of the rectum in concave bows to a junction on the posterior surface of the uterine neck. This is usually called the sacro-uterine ligament, or the musculus retractor uteri (Luschka); lig. utero-lombaires (Huguier); lig. utero-sacralia (Boivin and Dugès); lig. sacro-uterina; plicæ semilunares Douglasi; plicæ recto-uterinæ. Luschka describes it as composed of organized muscular fibres in addition to connective tissue. Schröder says that muscular fibres are very scarce. This ligament is apparent in the newborn, and may be rendered evident by drawing the rectum upward. In the adult dead subject, particularly those who have born children, the ligament is found in great variety of development. In some the surface is found with scarcely a trace of the peritoneal fold; and in others it is very prominent (Martin). Its bony attachment is a matter of dispute. Luschka alleges that it is attached to the second sacral vertebra, while Huguier says that it is attached to the lateral surface of the last lumbar vertebra. The function of the sacro-uterine ligament is also in dispute. Martin believes that it is of no small importance in defining uterine position; others, that it holds the uterus in its relative position in the cavity of the pelvis (Savage, Malgaigne). Many authors, reasoning from the evidence furnished by the dead subject, state that the ligament prevents to a certain extent, or is the chief obstacle to, prolapsus of the uterus (Hergott, Richet, Bastien, Le Gendre). Hueter states that it retards any considerable dislocation of the cervix forward, and consequently any corresponding escape of the fundus backward. The circumstance that the ligament is placed upon the stretch by a strong distention of the rectum, has led Klob to the conclusion that one of its offices is to prevent an otherwise inevitable pressure of the cervix upon the bladder, and by placing this restraint upon the forward movement of the cervix, causes the rectum to develop laterally.

Schultze takes the ground that the normal anteversion of the uterus is in a measure caused by it. Pausch has shown that the direction of its fibres are such as not to cause the movement of the uterus to any extent; that the fibres do not run so directly from the cervix backward as from below upward; that it exerts but little traction until its concave bows are partly obliterated, and that its power is greatly weakened by having no bony connection, its fibres being lost in connective tissue. In this opinion of its office Schröder coincides. To the foregoing it may be added that many authors deny this part any office as a ligament, and hold that it is a fold of the peritoneum developed by the downward traction of the uterus (Martin).

The balance of evidence is in favor of the value of the sacro-uterine ligament as a direct support of the uterus. Considered in its relations to other ligaments, we must also assign it value as an antagonist to the pubo-vesico-uterine ligament. It is difficult to agree with Klob that it antagonizes the round ligaments, since the sacro-uterine ligament retards any considerable dislocation of the cervix forward, and consequently of the fundus backward—an action, so far as the fundus of the organ is concerned, that is generally ascribed to the round ligaments. The action of the ligamenta pubo-vesico-uterina and the sacro-uterina is directly opposed. The former is known to be very much weaker than the latter, so that it would be overpowered, were it not for the considerable extent of connection between the cervix and the bladder. The idea of antagonism in the action of the various uterine supports must be accepted in a very modified manner. All speculation as to the antagonistic action of the ligaments is confronted by the fact that, with the exception of the round ligaments, all the so-called uterine supports are attached to the cervix and not to the uterus proper, and that consequently, to use the illustration of the long bones, its flexions cause extension, and its extensions, flexions; and further, that we cannot regard any set of ligaments as able to hold the uterus in a given direction contrary to the action of opposing ligaments.

(6.) It seems proper, in view of their mode of operation, to consider the (1) vagina, the (2) pelvic connective tissue, and (3) the levator ani muscle connectedly as a means of uterine support. These parts contribute more or less directly to give the

uterus a definite position. The action of the vagina and levator ani muscle, the latter by securing the vagina, and the former by securing the uterus, afford considerable support. It is difficult to agree with Mathews Duncan that the vagina is the chief means of uterine suspension; or with Martin, on the other hand, that it affords the organ no measure of support. The vagina is, however, a means of support, not from its inherent qualities, but that it shares with the uterus its own means of support. This is the pelvic connective tissue. By far the best description of this important tissue constituent of the pelvis is given by Savage. He makes the cellular tissue contribute directly to the support of the entire pelvic contents, with special processes for uterine support. "The pubo-sacral cellular process attends the urethro-vesico-vagino-uterine chain of venous plexuses, and forms a part of the utero-iliac cellular process, in the same way accompanies the uterine vessels, forming a resisting fibro-cellular bond between the uterus and the sacro-iliac articulation." The measure of movement allowed the uterus by its pelvic-cellular tissue supports is furnished by the tracings or uterine vibration movements to which former reference was made in this connection. The slight upward and downward movements in walking, and various other bodily actions, while too small to elicit any resistance from the ligaments proper, encounter the opposition of the cellular uterine connections. The downward movements record the limit of essential elasticity; the restriction of upward movement, due to recoil, being probably an expression of the same force.

C. Conclusions.

With the accumulated evidence of observers, and with that furnished by a study of the uterus and its attachments now before us, we are justified in expressing something like positiveness in the conclusions relating to uterine position and movement.

(*a.*) The most obvious conclusion is that the anatomical idea of coincidence between the uterine and pelvic axes, maintained with more or less relative exactness, is obsolete.

(*b.*) The evidence also establishes the fact that the uterus has, with relation to its neighboring organs, no definite posi-

tion. With these conclusions disappear the dogmas of older gynecology.

(*c.*) Instead we have the fact that uterine position must be defined as one of uterine movement.

(*d.*) These movements are not the effect of chance or of accident, but are the results of certain definite forces and counter-forces acting in fixed directions. While, however, the

Fig. 1.

uterus cannot be assigned a position typical of the normal unimpregnated organ, its range of movements is generally anterior to the pelvic axis; hence the theory of the normalcy of anteversion or flexion. The round ligaments, the ligamentous and cellular vesico-pubic attachments of the uterus, and the general direction of the superior strait in normal conditions of the lumbar curve, are the principal forces that produce this normal anterior position. These forces may also be defined as antagonists of vesical distention. To this source is due one

of the most extended and regular uterine movements. Between the positions of the uterus in an empty and in a full state of the bladder there is a difference of 20° to 30°. Inversely and to a minor degree the collapsed or full state of the rectum induces uterine movement, but only when the fundus is sufficently erect to impinge upon the anterior rectal wall, otherwise the displacing force is confined to the cervix.

(*e.*) The posture of the body induces uterine movement

FIG. 2.

either passively, as in gravitation of the uterus away from the vulva during the night, or actively, as in various bodily movements. The act of respiration in its various degrees, the force of the abdominal muscles, as in voluntary or involuntary expulsive effort, cause changes of uterine position mainly in the direction of the long axis of the organ.

(*f.*) We must also regard the uterine ligaments as the seat of motor influences; anteriorly acted upon by the round liga-

ments, the pubo-vesico-uterine ligaments and the vesico-uterine attachments which have the functions of ligaments; posteriorly by the sacro-uterine ligament and the occupancy of the recto-uterine pouch to a constantly varying degree by links of intestines.

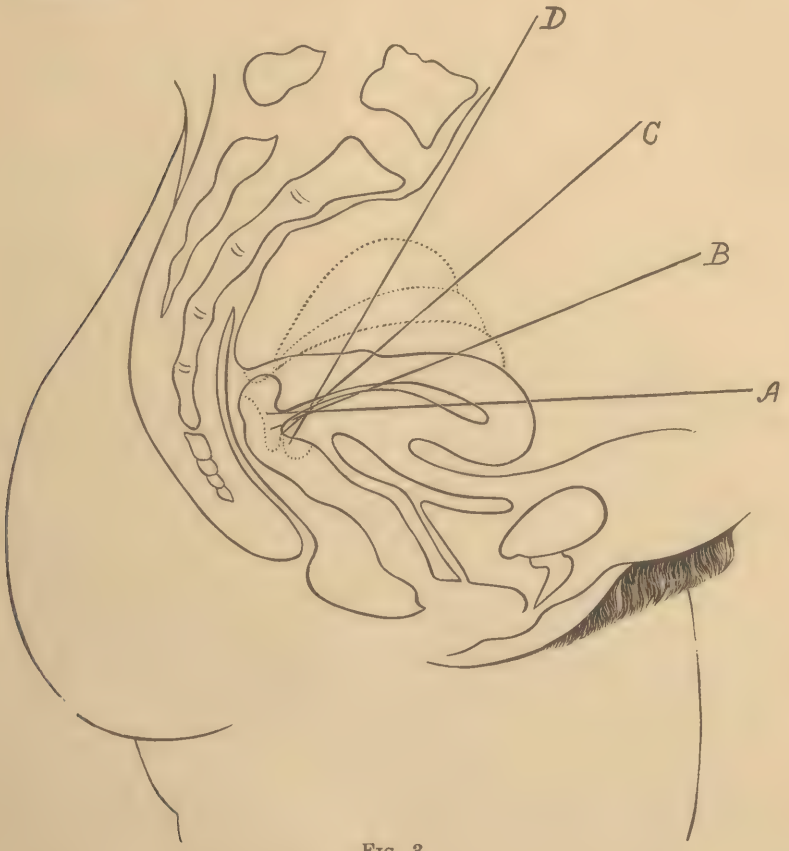

Fig. 3.

(*g.*) Antagonizing these forces and counterforces, we perceive but one normal force in the direction of fixation, namely, the pelvic cellular tissue with its more or less condensed utero-pelvic processes.

As the latest results of a careful study of one phase of uterine position, we have reproduced the figures of Schultze, copied from the Archiv für Gynaekologie, vol. viii., 1875. Fig. 1 represents the position of the virgin uterus with its

anterior curvature in an empty state of both bladder and rectum. Fig. 2 gives the form and position of the child-bearing uterus under the same conditions.

We have adopted Fig. 2 as the initial position of a series of normal uterine movements, represented in Fig. 3. It represents the constantly varying phases of uterine position induced by the action of the bladder, the rectum, the ligaments and bodily posture, intra-abdominal pressure. Figure 3 is designed to illustrate certain inevitable changes in position of the uterus due to the elevation of the fundus. The initial point is taken in the strong normal anteversion existing during a complete bladder collapse indicated by the line *A*. It has been shown that the bladder is able to raise the uterus through the angles expressed by the lines *B* and *C*. The line *D* is believed to express ideally the limit of the normal range of movements of the organ, of which postural changes may be the factor, complicated by visceral distribution and pressure.

We are obliged to admit that this process of partial revolution of the organ is performed under the operation of mechanical laws: hence, the fundus revolving on an unfixed centre, we have at the cervix a point that becomes depressed just in proportion to the elevation of the fundus. Since we cannot conceive of Aran's idea of an "axe suspenseur" as a fixed point, or that the organ becomes elevated throughout its mass, our assumption is ideally correct. The dotted lines at the cervix indicate approximately the depression of the uterus when elevated to correspond to the line *D*.

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